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THE EFFECT OF RED AND BLUE LIGHTING ON  
AUDIENCE RESPONSE TO A DRAMATIC PERFORMANCE

by

IRENE CLAUDETTE MORTON JOHNSON  
B.A. Montana State University, 1963


Presented in partial fulfillment of the requirements for the degree of

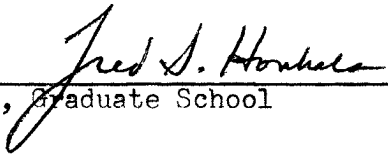
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## CHAPTER I

### INTRODUCTION

Art may be considered a reflection of the artist. His impressions are recorded for the purpose of calling forth in others, an audience, a re-creation of the mood or a subtlety of feeling which he expressed in his work.

Theatrical art, the play, created by the playwright, is stillborn. Some of its qualities can be seen in a silent reading, but not its true dramatic intention. To appear as a complete production, life must be breathed into it by the director, actors, and technicians, all of whom may be called interpretative artists. It is the director who heads this translation of written words into a specific combination of sounds and sights.

Interpretative art such as the theater, music, and dance has another special quality; that is its transient quality which makes its interpretation extremely complex. One can go again and again to a painting to contemplate it, but the play, once performed, is no more except in faulty retrospect. It might be argued that one can turn to the text of the play, but the play is much more than just written or spoken words. The media of dramatic art is visual and auditory images in everchanging relationships. Under the modality of sight are the elements of stage

design, costumes, lighting, movement, and the visual recognition of characters; while only the lines themselves, special aural effects, and the auditory recognition of characters belong to the modality of sound. Therefore, although recorded in written words, drama is primarily an art form to be "seen" as well as "heard".<sup>1</sup>

This has always been true, however, some elements have gained more importance as man progressed in technology. One such element is stage lighting. In ancient Greece the only lighting used in the theaters was primarily for visibility and was the general illumination from the sun. Any effects which were created were from natural phenomena, and the audience used its imagination for most of the lighting changes. Some scenes, however, which were supposed to take place at night were suggested by the actors carrying torches.<sup>2</sup>

For centuries most plays were performed during the day in order to take advantage of the natural light source -- the sun. As theater moves from Greece to Rome little change was made from a technical point of view. The shape was modified, and colored awnings were stretched over the large theaters. This was done mainly for protection from the sun, but as the awnings fluttered in the breeze, they colored the players and the audience with the transformed sunlight.<sup>3</sup> This is the first record of colored light on a stage; however, it was accidental, and was not used to any advantage.

With the death of the Roman Empire, organized theater also died not

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<sup>1</sup>Robert T. Ross, "Studies in the Psychology of the Theater", The Psychological Record (April, 1938), II, 5, pp. 127-128.

<sup>2</sup>Allardyce Nicoll, The Development of the Theatre (New York: Harcourt, Brace, and Company, (1946), pp. 80-81.

<sup>3</sup>Theodore Fuchs, Stage Lighting (Boston: Little, Brown and Company, 1929) p. 33.

to be reborn until the Christian church emerged as a dominant force in the eleventh century. The Church used drama as a vehicle to teach its lessons to the ignorant common man. Again, only general illumination was used in these productions. Fire in various forms was the main source of this general illumination. Outside, during the day, it was the sun which provided the best means of illumination, but inside and at night, blazing pine knots in iron cressets, oil lamps with open floating wicks, and by this time, the new form of artificial light -- candles -- were used. During this period, for the first time in the history of theater, special lighting effects were used to add frightening realism to the appearance of devils, angels, and fire breathing dragons. This was the introduction of fireworks in the theater.<sup>4</sup> Thus, in the twelve hundreds, theater began its long climb away from mere illumination of its productions toward the myriad of artistic effects which are used by the lighting designer everyday in modern theater to enhance a production.

It was not, however, until the sixteenth century that colored light was effectively produced for the stage. During this period, Sebastiano Serlio, an Italian architect, became interested in theater design. He suggested that colored light could be achieved by placing clear glass bottles filled with colored solutions in front of the oil lamps and torches which were used for general illumination of the stage. In order to obtain the effect of pink light bottles of red wine were placed in front of the light source. Amber light was achieved by placing

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<sup>4</sup>Ibid., p.34.



white wine between the lamps and the actor. Blue light, however, was more difficult to create. A solution of aquavita, vernis, and sulphuric acid had to be made and then placed in the clear bottles before the lights.<sup>5</sup> Real effects in colored light could now, for the first time, be achieved. Generally the lighting remained constant throughout the play and did not change from scene to scene because of the difficulties and time required to exchange bottles before the many lamps which were required for sufficient illumination and to extinguish and re-light them.<sup>6</sup>

Soon after the colored liquids were used successfully for light filters, Italian technicians also tried colored panes of glass. Placed in front of the light source, they proved to be much more dense than the colored liquids. This density absorbed so much of the light that their effectiveness was marred by insufficient illumination and they were seldom used.<sup>7</sup> With the advent of gas lighting and, finally, electric lighting, both of which produce a much stronger light source, the glass color filter took on greater importance. Today either glass or, more commonly, gelatin is used to filter the "white" light to the appropriate color. Only rarely, is a play produced using only "white" light. Plays by Bertolt Brecht are sometimes done this way, however, the majority of today's theater presentations are lit with colored light. The reason for doing specific plays and individual scenes in certain colors seems to come from a combination of theatrical traditions and individual artistic intuition on the part of the designer

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<sup>5</sup>Ibid., p. 35.

<sup>6</sup>Fuchs, op.cit., p. 36.

<sup>7</sup>Nicoll, op. cit., p. 96.

and director. The traditions seem to have a basis in acceptable color - mood associations and color - environmental associations. Blue lighting may be chosen to illuminate a scene because the scene is considered to be cold in mood, or blue light may be chosen because the setting of the scene is night. In the decision, as to what shade of blue the lighting should be used, artistic intuition is exercised, and it is hoped that the essence of a feeling or idea is interpreted or created for the audience.

In recent years color has been the object of many studies and experiments in physics, biology, and psychology, yet almost no studies have been done on its specific effects in the theater. As has been stated earlier in this paper, drama is an art. It is not the purpose of this study to reduce this art to a set of mathematic equations or scientific laws, for psychologists have found how very difficult it is to measure aesthetic experience objectively. It does, however, seem valid to try to test these traditions and artistic intuitions, and to try to discover their genesis and their stability. This then is the purpose of this paper.

Its scope will include a review of past studies and experiments made, not only of colored lighting in the area of the theater, but also, in the fields of psychology, biology, and physics which have some bearing on this subject. It is hoped that this section will show how this specific experiment relates to previous studies and what, if any, its significance is. This chapter will be followed by a description of the experiment: the subjects, the materials, and the procedure. Chapter Four will include the presentation and interpretation of the data, and

if possible, an answer to the specific problem of the experiment. This study will conclude with a summary of the results of the experiment and the composite findings of the other studies, along with suggestions for its application and further research possibilities in the area of the use and effect of colored light in the theater.

## STATEMENT OF THE PROBLEM

In stage lighting and stagecraft courses, as well as stage make-up and costuming courses, students are taught always to be aware of colored lighting in planning and executing their part of a production. It is considered useful in simulating natural light sources, i.e., the sun, moon, and fire, adding plasticity to the actors and set pieces, and most important, creating the desirable mood for the particular production.<sup>8</sup> It has long been a theater axiom to light comedies in warm pinks and ambers and tragedies in cool blues and lavenders.

The importance of colored light to the actor appears obvious in his reactions to it at the first technical rehearsal and later to unexpected changes in the lighting situation. In actuality though, there is no specific proof as to its importance, nor is there anything, any tangible evidence, which specifically explains the extent of its effect on the actor. Perhaps the actor is not at all effected by the colored light, but rather it is the audience who strongly react to it. Finally, there has been no proof or study which definitely concluded that the use of colored light makes a real difference to either the actor or the audience. It may be that there never will be definite proof to preferences in art, yet the proposed experiment will try to discover specifically:

1. Does colored light have any effect on a dramatic performance?
2. If so, does it affect the actor, or the audience, or the actor and the audience?

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<sup>8</sup>Wayne, Bowman, Modern Theatre Lighting (New York: Harper and Brothers, 1957), p. 4.

## DEFINITION OF THE TERMS

In order to avoid confusion and misunderstanding in the discussion of this study, it is necessary that the terms used in the experiment be specifically defined so that there will be a common interpretation of the material. The definitions given below are, in some cases, specific ones useful for the study.

Light

Radiant energy with an electromagnetic wave-length between .00004 and .00008 centimeters and visible to the eye, produced by very hot bodies and ioned gases, and traveling at 186,000 miles per second.<sup>9</sup> More specifically, for this study, it is the radiant energy produced by an electric incandescent light source.

Colored

A state or condition achieved which only allows the wave-length of one color to pass. The filter which was used to achieve this condition in the experiment was Brigham gelatin which is a thin sheet of animal gelatin containing pigment.<sup>10</sup>

Colored Light

A specific wave-length within the visible spectrum. Red has the longest wave-length visible. The wave-length decreases through orange, yellow, green, blue, to violet which has the shortest wave-length visible. The light primaries are red, blue, and green. They can be combined to

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<sup>9</sup>Robert H. Carleton, Vitalized Physics (New York: College Entrance Book Company, 1957), p. 181.

<sup>10</sup> Bowman, op. cit., p. 195.

form any other light color.

It is necessary, also, for this study, to be aware and understand the three physiological aspects of color. They are hue, saturation, and brilliance. Hue is the color: red, orange, etc. Saturation is the absence of white light, i.e., pink is not as saturated as red, and Brilliance is the intensity of light, i.e., a 100 watt lamp is more brilliant than a 50 watt lamp.

### Colored Pigment

A surface which when struck by light, selectively reflects part of the wave-lengths, the color one sees, and absorbs the rest. It is that reflected hue which names the pigment. For example: A book whose cover is seen as red is really one whose cover absorbs all of the wave-length of other colored light except red. This it reflects and that is what is seen as red. If all of the light is absorbed then black is seen and, if all light is reflected, white is seen. It is necessary to remember that if a colored light is shone on a colored object unless that object has been reflecting some of that color under white light, it will look black or gray.

### Increase

To become or cause to become greater is the meaning this study uses.

### Effect

The condition or fact of being operative or in force; anything brought about by a cause or agent; result.

### Dramatic

Having the characteristics of drama.

Performance

The execution of a prepared scene by live actors which is an entity in itself, and which is presented under normal theatrical running conditions, i.e., in a theater, on a stage, and before an audience.

Affect

The ability to produce an effect or impression, or feeling.

Actor

A person with experience in performing plays, and with a level of ability in this area which qualifies him to be competent and effective in portraying a character on stage.

Audience

People who watch a performance.

## CHAPTER II

### A REVIEW OF ASSOCIATED STUDIES

The effect of color on man and his environment has long fascinated the scientist. The artist, too, down through the ages, has experimented with the subtleties of color. Though there have been many studies of color preference, reaction to color, and the effects of color, there have been almost no studies as to its effect in the world of art. It is to these studies, in the fields of physics, biology, and psychology that one must turn first to see if any of their conclusions are applicable to the world of the theater.

Though evidence of color experimentation shows results, the reason for these results remains for the most part unknown. Investigators in this area are able to show evidence that people are effected and do react to color and colored light, but all that can be offered as to why they react the way they do are educated guesses. For the most part, the basis for these reactions can not be found or measured, and at present, appears a mystery.

There are, however, two types of color effects: direct and symbolic. The first type is an immediate response to the color alone. The second type involves some sort of association of color with an object or an idea, and the color is reacted to, at least partly, on the basis of what it symbolized.

Raymond B. Abbott explains the different effects of colored light on the human organism by saying:

The effect of any color is influenced by its quality, intensity, and predominance, and by the duration of one's exposure



to it. It is influenced, besides, by the age, sex, and race of the observer. Color may appeal to the intellect or to the emotions depending upon the development of the individual. . . . The influence that color can exert on the mind of a man depends on the sensitiveness /sensitivity/ of the individual. An individual's alertness, the state of his nerves, his general health, the coordination of his parts, his experience, his education, and by other factors. The impressions received are closely dependent upon associations and the past experiences of the observer. The effects of color on the human organism are as yet only vaguely understood. It is known that under certain conditions, visual impressions (including color) affect the blood pressure and muscular, mental, and nervous activity and mood.<sup>1</sup>

From the preceding statements it may be seen how truly complex and how little is known in the area of the effects of color on life.

#### Direct Effect of Colored Light

With regard to the effect of colored light on plants, Abbott stated:

the natural growth of plant life depends on light that is visible to us. . . . each color contributes to some specific process, and . . . a preponderance of invisible light is destructive.<sup>2</sup>

Experimentation seems to justify these statements. Seed germination studies showed that while under normal conditions certain seeds require eight days to sprout, under blue glass, they will sprout in two days.<sup>3</sup> Other investigators found that the effect of colored light was not

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<sup>1</sup>Raymond B. Abbott, The Color of Life (New York: D. Van Nostrand Company, Incorporated, 1938), p. 129.

<sup>2</sup>Ibid. p. 134.

<sup>3</sup>Howard Ketcham, "Color Schemers", Reader's Digest, XXX, (March, 1937), pp. 47-50.

limited to plants. Earthworms were strongly attracted by blue light,<sup>4</sup> and larvae of the flesh fly were three times as big when raised under green glass as compared to those raised under violet glass.<sup>5</sup> Tadpoles appear to grow much better under violet or blue light than under normal "white" light, and when fish were hatched under several different colors of lights, those under violet light hatched most rapidly.<sup>6</sup> The preceding studies are only a few illustrations. There have been several other experiments which conclude that plants and the more simple forms of animal life seem directly effected by colored light.

The primary concern of this study, however, is the effect of colored light on man. Abbott did not limit his compilation of color effect to the lower forms of life. He discussed tests made on muscular activity as affected by colored light. The results were measured in arbitrary units of energy. Specific results of the tests were as follows:

23 units - ordinary light  
 24 units - blue light  
 28 units - green light  
 30 units - yellow light  
 35 units - orange light  
 42 units - red light<sup>7</sup>

From this, one can see that the muscular activity was strongly increased as the light changed from what is traditionally considered the "cooler" colors to the "warmer" ones.

Besides increasing muscular activity, the warmer colors seem to stimulate sexual activity by stimulating the pituitary gland which then

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<sup>4</sup>S. O. Mast, "Realative Stimulating Efficiency of Spectral Colors for the Lower Organism", Scientific American Supplement, LXXXI, (February 26, 1916) p. 144.

<sup>5</sup>Havelock Ellis, "The Psychology of Red", Popular Science Monthly, LVII, p. 518.

<sup>6</sup>Ibid.

<sup>7</sup>Abbott, op. cit., p. 129.

ejects powerful hormones into the blood stream.<sup>8</sup> Red light appears to cause an enlargement of glands in birds and increase sexual activity. On the other hand, violet light seems to cause a reduction of these glands.<sup>9</sup>

Faben Birren in Selling with Color noted that even blindfolded subjects were affected by colored light. When they stood with their arms extended in front of them, red light caused them to spread their arms apart and green light caused them to bring their arms together.<sup>10</sup> The reasons for the reaction to the colored light when it is not perceived by the eyes is not known, but it does occur and must be considered a direct reaction with no chance for symbolic association of the colored light.

Riley Spitler used color to stimulate or relax eye nerves and found that colored light was very useful in relieving different types of minor illnesses. He was able to stop headaches brought on by tension with blue or violet light, to relieve some types of dizziness with red light which increased the blood pressure, and to help certain digestive illnesses with yellow, green and blue light.<sup>11</sup>

Edward Podolshy wrote of the direct physiological effects of colored light on the body in his study The Doctor Prescribes Color. He found that green light seemed to affect the nervous system like a sedative and is hypnotic and anodyne. It is therefore useful in treating nervous irritability, sleeplessness, and exhaustion because it lowers

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<sup>8</sup> Ibid., p. 130.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid., p. 131.

<sup>11</sup> Ibid.

the blood pressure by relieving tension, causes a sensation of warmth by dilating the capillaries, and relieves neuralgia and headaches associated with high blood pressure. Blue light, on the other hand, appeared to raise the blood pressure by contracting the arteries and to have a tonic effect on the blood. It seemed to be antiseptic and to lessen suppuration, but an over exposure to blue light appeared to cause tiredness or depression. Orange light seemed emotionally stimulating and to increase the pulse rate. It seemed, however, to have no effect on the blood pressure, but it appeared to promote a sense of well being. Yellow light appeared to be a mental stimulant, especially to the mentally deficient. It also seemed beneficial in treating tuberculosis for it counteracts the vibrational rate. Red light, too, appeared to be a mental stimulant, warm and often irritaion. In fact, it seemed to increase any inflamation and the activity of the male sex glands. It had, however, been found effective in treating melancholia. On the other hand, when red lighting was changed to green lighting in a French photography factory, the temperament of the workers became more tranquil. Violet light seemed to act on the heart, lungs, and blood vessels and increased tissue resistance. In addition, it appeared to increase the activity of the female sex glands.<sup>12</sup>

It may appear at first that already there is a discrepancy between investigators as to the effect of red and violet light on the sex glands. It should be kept in mind that Abbott's study dealt with birds and did not mention the particular sex, while Podolshy's study was concerned with human beings and discusses the reaction of the male and female

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<sup>12</sup>Ibid., pp. 132-133.

sex glands to the colored light. Therefore, there may be in reality no conflict in the differences of the conclusions of the two studies.

While most scientists working in the field agree that light in some form seems to have an effect on all parts of the human body, most feel as do Luckiesh and Pacini when they state that by no means are the color factors great in preserving life and health. They are in fact, rather feeble, but they should not be ignored,<sup>13</sup> and so the experiments continue.

The effect of red light on hemoglobin and metabolism, though not definitely proven, shows some support for a feeling that these two bodily functions are affected and increased by the colored light.<sup>14</sup>

During the middle ages red curtains or carpets were placed in the rooms of those afflicted with smallpox.<sup>15</sup> Luckiesh and Pacini in recent investigations have refuted the theauputic value of red light in treating smallpox.<sup>16</sup> They feel that the heat produced by the red light was its only benefit. On the other hand, they found that yellow light permeates human tissues deeper than any other color. It probably does so by being converted to heat.<sup>17</sup>

The studies discussed thus far have all been concerned with the therapeutic value of colored light. Parsons, Ketcham, Luckiesh, and Pacini, all feel that blue light is a great calmer and soother of nerves, while red light is a stimulant. In addition, they feel that these hypotheses can be used in the treatment of mental disorders.<sup>18</sup>

It would appear that studies involving the eye, the organ whose

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<sup>13</sup>Matthew Luckiesh, Torch of Civilization (New York: G.P. Putnam's Sons, 1940), p. 266.

<sup>14</sup>Ellis, op.cit., p. 520.

<sup>15</sup>Ibid.

<sup>16</sup>Ibid., p. 519.

<sup>17</sup>Luckiesh, op. cit., p. 181.

<sup>18</sup>Ibid., p. 102.

specific function is the perception of light, would show the strongest direct reactions to colored light. As early as the 1860's, H. Auber was experimenting in the area of color saturation. In 1865 he published his first findings in Physiologie der Netzhaut, and in 1876 he published later studies in Grundzuge der Physiologischen Optik.<sup>19</sup> L. H. Geissler, an American scientist, read of Auber's research and decided in 1913 to experiment in this area himself.<sup>20</sup> He examined several subjects as to their sensitivity to color saturation. He tested each eye separately and then both eyes together. He found that no two eyes, even on the same subject, saw color saturation exactly the same, and that in fact, there was a wide variation between subjects and even between the two eyes of the same person.<sup>21</sup> Due to this difference, what may appear to one person as a very beautiful bright red, may appear to another as a harsh, glaring, unpleasant color. More recent studies have confirmed this variety of sensitivity to color saturation.

The human eye is repelled by glare. It is designed for much light diffused rather than a small amount of light intensified.<sup>22</sup> In nature the brightness is elevated and shades down to low brightness below the horizon. The eyelids are constructed for this natural illumination. Therefore, it is most natural and most satisfactory to have rooms lit at ceilings rather than at the floors, or below eye level.<sup>23</sup>

The reaction of man to light is slower than to sound or touch, and

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<sup>19</sup>L. R. Geissler, "Experiment on Color Saturation", American Journal of Psychology, XXIV, 1913, p. 171.

<sup>20</sup>Ibid.

<sup>21</sup>Ibid.

<sup>22</sup>Matthew Luckiesh, Light and Work, (New York: G.P. Putnam's Sons, 1943) p. 267.

<sup>23</sup>Ibid.

increasing the area of the light surface decreases the reaction time.<sup>24</sup>

The eye's reaction to any external stimulus is stated in Muller's law:

The same external stimuli arouse in the different sense mechanisms different sensations according to the particular sense; different external or internal stimuli acting upon the same sense mechanism, always arouse the same sensation.<sup>25</sup>

In order to excite a sensation, a stimulus must attain a certain intensity. A stimulus of greater intensity excites a stronger sensation. The minimum stimulation is called the general threshold or general liminal value.<sup>26</sup> Thus, it is possible for colored light of low intensity to excite a sensation; when it is of a higher intensity it may excite a sensation of color. The intensity of the stimulus must be raised a certain degree before one can notice any change in sensation.<sup>27</sup>

Color is seen in a definite time or place. It does not seem a part of the thing itself, but rather it exists as a light sensation.<sup>28</sup> Because of mental association, a page of a book is always seen as white and the print on it as black no matter what color or type of light under which it is actually read. To a certain extent it may be true that simply because a man is aware that it is evening, he subtracts yellow and adds blue to every color he sees, just as he subtracts red from a snowy mountain peak illuminated by the setting sun, and thus, sees it still as white, and not pink, snow.<sup>29</sup>

When the eye sees small dots of color it moulds them into one composite.<sup>30</sup>

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<sup>24</sup>R. Woodworth, "Psychology of Light; the Subjective Aspect of Optics", Scientific American Supplement, LXXII, 1911. p. 419.

<sup>25</sup>J. Herbert Parsons, An Introduction to the Study of Colour Vision (New York: J.P. Putman's Sons, 1915) p. 18.

<sup>26</sup>Ibid., p. 19.

<sup>27</sup>Ibid.

<sup>28</sup>Ibid.

<sup>29</sup>Leonard T. Troland, "Psychology of Color", Scientific American Supplement, LXXXVI, (August 24, 1918) p. 114.

<sup>30</sup>Ibid.

Once the eye becomes accustomed to one color, the level of illumination is lowered and the retina is smeared with its complementary. This is called a Chromatic Dimming Effect. Thus, evening light, though yellow, will appear blue which is the complementary of yellow.<sup>31</sup> In addition, it is thought that the residual effects of the exposure of the retina to colored light will persist for a considerable length of time. In fact, there is good empirical evidence that this persistence increases with the intensity and the duration of the exposure. This is called the Asympatic Law of Color Adaptation.<sup>32</sup>

From the previous discussion, it can be seen that colored light does have many direct effects on man. There is strong evidence that in many ways it is useful in the treatment of mental and physical illnesses.

#### Symbolic Effect of Colored Light

It is the purpose of this section to examine the research which involved the effect of colored light on man and his reactions to it when he regards it in a symbolic or associative way.

Dr. Ernest Schachtel in an article called "On Color and Affect"<sup>33</sup> discusses the effects and association of each color. Red, he feels, is the most striking, strongest, and most vehement color. It readily catches a person's attention even on primitive levels of perceptive and mental organization. Children seem to react first to red, and some primitive tribes seem to react primarily to red. For the unconscious, it is the most attractive and yet most dangerous color, and it is always very

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<sup>31</sup>Ibid.

<sup>32</sup>Ibid.

<sup>33</sup>Schachtel, op.cit., pp. 399-402.



fascinating. Yellow, while not as striking and dramatic as red, is allied to it. Children like yellow as much as red, but as people grow up the Christian culture with its associations of yellow to traitors and cowards seems to condition them against it. In contrast green preference was developed with the rise of Puritanism in the seventeenth century. It suggests the romantic and sentimental view of the landscape and nature.<sup>34</sup>

1. Probable Symbolic Reactions. - The first group of studies are those in which it is not definitely known if man is reacting in a symbolic way. That is if his reaction to colored light is due to his connecting the color with an idea of seeing it as a symbol for something else rather than just the pure, immediate, direct response.

Experiments involving the insane, although without conclusive results, indicate that blue light seems to have a soothing effect on raving maniacs, and red light seems to cheer the taciturn, at least under red light they will eat more readily.<sup>35</sup> The specific nature of this effect was not ascertained in the study. It may be direct, but it seems more likely that it is a symbolic effect.

Luckiesh states that people work better in white light than in yellow light. The individuals, themselves, prefer it for doing work and seem to associate yellow light with relaxation.<sup>36</sup> Hugo Munsterberg found that nonuniform light is best for every type of mental activity. He noted too, that colored lights which are felt to be pleasant by no means produce more favorable working conditions. In addition, he found that some people work

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<sup>34</sup>Ibid.      <sup>35</sup>Ellis, op. cit., p. 520.

<sup>36</sup>Matthew Luckiesh, Light and Work, op. cit., p. 109.

up to twenty percent more slowly under the influence of one color.<sup>37</sup> Further experimentation showed that tapping was fastest under red light, slowest under blue light, and most uniform under green light. Arithmetic improved when done under red light or with an increase in brightness.<sup>38</sup> These results seem consistent with the other experimental results and theories in which red was considered a stimulant and blue a depressant.

Sidney L. Pressey, conducted an experiment involving the effect of color and light on motor efficiency much like Muensterberg and found that brightness increased the function in tapping, and multiplying, but over-all hue had little effect except that there were marked individual differences in feeling toward brightness and especially toward hue. Pressey explained, "of seven subjects, five . . . show an increase in rate of tapping with bright light and a decrease in dim light."<sup>39</sup> The rate of multiplication slowed somewhat under dim light and speeded up under bright light. Hue gave no consistent results, although there was some tendency to do more rapid work in blue light and slowest in green.<sup>40</sup> This does not conform with the other results, however, it must be kept in mind that these were not consistent results.

2. Color Preference.- Experiments and studies in color preference have been going on since Cohn began in 1894.<sup>41</sup> It was not until 1931, however, that experiments were done which were specifically

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<sup>37</sup>Hugo Muensterberg, "Psychology and Light", Scientific American Supplement, LXXXII, (December 23, 1916) p. 407.

<sup>38</sup>Ibid.

<sup>39</sup>Sidney L. Pressey, "The Influence of Color upon Mental and Motor Efficiency", American Journal of Psychology, XXXII, p. 342.

<sup>40</sup>Ibid.

<sup>41</sup>H. J. Eysenck, "A Critical and Experimental Study of Colour Preferences", American Journal of Psychology, LIV, 1941, p. 385.

concerned with preference in regard to colored light. Up to that time only colored pigment preference had been examined. Such investigators as M. F. Washburn,<sup>42</sup> E. G. Bradford,<sup>43</sup> and H. F. Eysenck<sup>44</sup> were prominent in this field. Though the concern of this study is colored light it is interesting to note that the results achieved in the colored pigment research is not so very different from the conclusions reached in the colored light studies.

It was not until 1931 that the first study involving colored light preference was done. William E. Walton and Beulah M. Morrison used for the light source five Mazda lamps in which the glass itself was colored. The colored light was presented to college students through the use of the chromopathometer which throws discs of diffused light on a frosted glass screen. The subjects rated the colored light by paired comparison. The room in which the experiment was performed, though in semi-darkness, had enough light for the subjects to mark their reaction on a record sheet. The conclusions showed first of all that women are more changeable than men in their selection. The specific results were as follows:

<u>Men - 180</u>	<u>Women - 163</u>	<u>Combined</u>
Blue	Green	Blue
Red	Red	Green
Green	Blue	Red
Amber	Amber	Amber
Clear	Clear	Clear <sup>45</sup>

Further experimentation by Walton and Morrison showed preferences for

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<sup>42</sup>M. F. Washburn, "A Note on the Affective Value of Color", American Journal of Psychology, XXII, 1911, pp. 114-5.

<sup>43</sup>E. J. Bradford, "A Note on the Relation and Aesthetic Value of the Perceptive Types in Color Appreciation", American Journal of Psychology, XXIV, 1913, pp. 545-54.

<sup>44</sup>Eysenck, op. cit., pp. 385-94.

<sup>45</sup>William E. Walton and Beulah M. Morrison, "A Preliminary Study of the Affective Values of Colored Lights", Journal of Applied Psychology XV, 1931, p. 298.

two colors viewed at the same time next to one another. The men subjects in the study seemed to prefer combinations of two saturated colors; red and blue in combination was always picked first followed by green and blue, and red and green. On the other hand, the women subjects were thought to prefer combinations of one saturated color and one unsaturated color. Clear and green were chosen first except when intensities were equated. Then amber and green were most preferred.<sup>46</sup>

In the experiments the reasons for liking or disliking colors and combinations were:

1. Suggested clothing worn by observer or acquaintances
2. Suggested or aroused an emotional state
3. Harmony of contrast of two colors pleasant or unpleasant
4. Suggested out-of-doors or seasons
5. Are over-popular
6. Resembled colors of organizations - classes, clubs, schools
7. Recalled specific experiences or have symbolic meaning - accidents, blood, cleanliness
8. Choice is due to personal taste or feeling, conditioning the factors have been forgotten.<sup>47</sup>

In addition to his other studies in the area, Pressey found that color preference changes with age and that, though there is an early fondness for bright colors in pigment, it decreases with age.<sup>48</sup> Concerning preference of light Pressey's study showed that people regard very bright lights as most pleasant, dim lights as least pleasant, and are indifferent to medium intensities of light.<sup>49</sup>

In general, it may be concluded from all of the preceding studies that the most preferred colors, either light or pigment, are blue and green closely followed by red. The conclusions are interesting in that the colors most preferred are the colored light primaries, and also

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<sup>46</sup>Ibid., p. 300.

<sup>47</sup>Ibid. p. 302.

<sup>48</sup>Pressey, op. cit., p. 328.

<sup>49</sup>Ibid., p. 351.

because blue and green are the two pre-dominating colors in man's natural environment.

In all of the previously discussed preference studies, the subjects judged color alone. In the following studies it may be noted that preferences change when the color is applied to an object and the frame of reference changes.

In 1960, Benjamin Wright and Burleigh Gardner did a study involving the interaction of color on black and white pictures.<sup>50</sup> The experiment was done in Chicago using 930 men from twenty-five to fifty-five years of age, two-thirds of whom were semi-skilled, clerical or sales workers, the rest did professional or managerial work. The subjects judged three colors: red, blue, and yellow which were presented to them on paper squares. They also judged four pictures: a black and white, a red background, a blue background, and a yellow background. All of the colors were judged good:

Blue best  
Red better  
Yellow good

In addition blue was judged safest, but yellow was somewhat safe. Only red was judged exciting. All of the colors were considered strong; red was the strongest and yellow the weakest. When the colors were added as background to the black and white pictures, the red picture was judged strong and exciting, and the rankings of all three colors and identical colored pictures correspond exactly on strong and exciting. The experimenters noted that the results of their study were consistent with an additive

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<sup>50</sup>Benjamin Wright and Burleigh Gardner, "Effect of Color on Black and White Pictures", Perceptual and Motor Skills, XI, 1960, pp. 301-304.

explanation of the influence of color on meaning. Color, introduced into a context, appears to have the effect of moving the meaning of the context in the direction of the introduced color.<sup>51</sup> The addition of blue did not make the picture good and safe; it hardly changed the meaning at all. On the other hand, red the least safe color when added to the picture produced pictures judged the best and safest. Neither the red square nor the black and white pictures alone are judged good or safe; it is only in combination that the effect is achieved. From the results the investigators derived the following conclusions:

We propose that the black and white pictures represent too much control while the square of red represents too much impulse and that their combination produces a color-form balance less provocative of anxiety, yet more emotionally satisfying than either alone. The preference for the red picture over red alone or over black and white pictures seems to us to be an indication of the human organism's need for the right amount of stimulation, of the need to maintain a balance between the avoidance of too much and the search for enough; a balance between the longing for peace and the hunger for life.<sup>52</sup>

Charles E. Osgood in his book, The Measurement of Meaning, discusses the results of a study called, "Effects of Color on the Meanings of Advertised Products".<sup>53</sup> There was a consistent response in which red appeared to make the products warmer and blue-green made them appear cooler. Second there was an interaction between color and product. Cultural conditioning seemed to have affected this area. For example a violet auto was favorably judged, but not a violet cake. Third, generally speaking pastel colors on products and in the backgrounds produced small but consistently more favorable judgments than intense colors. Finally, color in background, was

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<sup>51</sup> Ibid., p. 303.

<sup>52</sup> Ibid., pp. 303-304.

<sup>53</sup> Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning (Urbana: University of Illinois Press, 1957), p. 300.

over all more favorable than color in the product. This study was useful in predicting public opinion about specific articles and in determining the best way to use color in advertising them.<sup>54</sup>

When an object is introduced the interaction of the color and the object become more important than just the color itself and preferences are made on that basis.

3. Color and Mood:- In 1938 Robert Lewinski became interested in colors and their meanings and emotional effects. He was aware that colored illumination was used in the theater, in advertising, and in interior decoration. He took into consideration the fact that it had long been held that colors have definit meanings and symbolic values, and that colors in illuminants are generally much more powerful emotionally than in objects.<sup>55</sup> /Illuminants produce colored light, while objects have surface coated with pigment which only reflects colored light.<sup>7</sup> His subjects were twenty-five men and twenty-five women, all students at the University of Iowa. He seated them one at a time in a lightproof experimental room, in which the walls were painted flat white. The source of illumination was two floodlights, located immediately behind and above the subject. The lights had rectangular apertures eleven inches by nine inches and equipped with clear 300 watt incandescent bulbs. They were located as to insure an even illumination over the

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<sup>54</sup>Ibid., p. 301.

<sup>55</sup>Robert J. Lewinski, "An Investigation of Individual Responses to Chromatic Illumination", Journal of Psychology, VI, 1938, p. 155.

entire reflecting surface, and so that each subject's entire field of vision (except for small peripheral portions at the floor and ceiling) was stimulated. Six color filters were used; all produced well saturated chromatic illumination. The colors used were red, yellow, purple, orange, blue, and green. The subjects were presented with the colored illuminant three times in succession, and they were instructed to react after each stimulation in terms of three dimensions: pleasant to unpleasant, stimulating to depressing, and cold to hot. These were each rated on a five step scale in which the middle step was neutral.<sup>56</sup>

The results were:

1. <u>Pleasant - Unpleasant</u>		
Blue - Pleasant	59	
Green - Pleasant	23	
Purple - general disagreement	9	
Red - general disagreement	-3	
Orange - unpleasant	-33	
Yellow - unpleasant	-38	
2. <u>Stimulating - Depressing</u>		
Orange - Stimulating	66	
Red - Stimulating	64	
Yellow - Stimulating	44	
Green - neutral, disagreement	10	
Blue - almost neutral	8	
Purple - definitely depressing	-10	
3. <u>Cold - Hot</u>		
Blue - Cold	52	
Green - Cold	36	
Purple - almost neutral	-4	
Yellow - hot	-13	
Orange - hot	-58	
Red - hot	-78	57

Mr. Lewinski felt that it was important to remind the reader in regard to his study that:

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<sup>56</sup>Ibid., pp.,155-156.

<sup>57</sup>Ibid., pp. 158-159.



the existence of environmental objects (absent in this experiment) which would be subject to effect by the illuminants, as well as the factor of prolonged stimulation, might tend to alter individual reactions appreciably.<sup>58</sup>

Similar studies in which subjects were asked to associate specific hues of colored pigment with mood-tones have been done by Lois B. Wexner<sup>59</sup> in 1954 and later in 1957, by D. E. Murray and H. L. Deabler.<sup>60</sup> In general the results were similar to the colored light and mood-tone study previously discussed. It was found that there were no significant sex differences in associations, and they appeared to be made because of cultural factors, biological determinants, and particular learning situations.<sup>61</sup> The later study definitely supported the contingency that associations are due in a large part to cultural and even sub-cultural socioeconomic levels.<sup>62</sup> Therefore, it seems important in studies of this sort to consider learned responses and the background of the subjects when drawing conclusions.

4. Rorschach and Color.- Closely associated to studies of color and mood-tone is the way that people respond to color when it is used on the Rorschach ink blot test which measures personality. The Rorschach investigators note what they consider a color response when the subject interprets the blot partly or entirely by color, i.e., a subject calling a red blot fire.<sup>63</sup> When color responses are given

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<sup>59</sup>Lois B. Wexner, "The Degree to which Color (Hues) Are Associated with Mood-Tones", Journal of Applied Psychology, XXXVIII, 1954, pp. 432-5.

<sup>60</sup> D.E. Murray and H.L. Deabler, "Color and Mood-Tones", Journal of Applied Psychology, XLI, 1957, pp. 279-83.

<sup>61</sup> Wexner, op.cit., p. 433-4.

<sup>62</sup> Murray and Deabler, op. cit. p. 283.

<sup>63</sup> Ernest G. Schachel, "Color and Affect", Psychiatry, VI 1943, pp. 393-4.

by a subject they appear to be immediate reaction to the stimulus, with no delay.<sup>64</sup> Three psychologists who have done a great deal of work with the Rorschach test, Ernest Schachel, Maria Rickers-Ovsiankina and D. Rapaport, feel that it is necessary to understand the meaning of the color response in terms of the perceptual and/or thought processes involved.<sup>65</sup> Though Schachtel calls the condition by which a color response is attained "passivity", Rickers-Ovsiankina calls it "immediate", and Rapaport calls it "short-circuiting", all three investigators seems to feel that the process of color perception is one which requires less delay, less effort, or less ego activity than form perception.<sup>66</sup> The validity of this assumption has been substantiated by experiments in which both primitive and complex reactions could be obtained. In every case the color responses were made by subjects who would normally give a more primitive response; very young children, brain damaged adults.<sup>67</sup> Also, tests which required extreme speed were color responded to even by normal adults when given a choice.<sup>68</sup> It appears that the assumption is true. Shapiro sums up the idea:

The more immediate the response to a sensory stimulus, i.e., the less activity that intervenes between the effective presentation of the stimulus and the organization of some sort of perceptual response, the lower the perceptual threshold for that stimulus.<sup>69</sup>

If this is excepted, then color has a very low perceptual threshold.

Rorschach investigators have also found that an accuracy of form perception decreases with an increasing amount of color responses.<sup>70</sup>

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<sup>64</sup>Ibid., p. 397.

<sup>65</sup>David Shapiro, "Color-Response and Perceptual Passivity", Journal of Projective Techniques, XX (March, 1956), 1, p. 53.

<sup>66</sup>Ibid., pp. 54-5. <sup>67</sup> Ibid., pp. 56-61. <sup>68</sup>Ibid., p. 60. <sup>69</sup>Ibid., p. 62.

<sup>70</sup>Ibid., p. 60.

There are, Rorschach feels, two groups of "normal" people who can make an exception to the rule. The artists and "nervous" people are able to combine accuracy of form perception with many color responses. He believes this is possible because these people are more sensitive and have a richer life with emotions. They are able to combine "objective and precise perceptiveness with a sensitivity to the charm, power, and vividness of color, to combine realistic and critical thought with affective responsiveness."<sup>71</sup> This is an important consideration in the study and it will be worthwhile to keep it in mind.

5. Synaesthesia and color effect in art.- In normal psychology the term synaesthesia means that one specific stimulus may arouse not only the appropriate sensation but a second sensation which is united with the first.<sup>72</sup> A common example of this is when a person listening to a tone sees a specific color as well.

In primitive societies synaesthesia seems to be much more important than in our own complex culture. Children, too, seem to react more in this manner. This may be due to the fact that all of the senses are bound together at birth and the child must learn to separate them and to put the appropriate sensation with the appropriate sense.<sup>73</sup> Color is often confused or used as an expression of a sensation which is not visual. Small children sometimes make such comments as: "The leaf smells green" or

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<sup>71</sup>Ibid., p. 406.

<sup>72</sup>Heinz Werne, Comparative Psychology of Mental Development (New York: International Universities Press, Incorporated, 1957), p. 86.

<sup>73</sup>Ibid., p. 89.

"The golden ringing". This particular form of synaesthesia is called chromaesthesia or color experience in perception where there is no sight involved.<sup>74</sup> As children become older, parents explain to them that they are using words incorrectly. The parents do not realize that it is not just a misunderstanding of words, but that the children really do experience these sensations.<sup>75</sup>

The world of art seems to be the last vantage point for synaesthesia in our complex civilization. A painting may be described as "noisy", or a tone in music by a specific hue, or a singer is told to put more color in his voice. In speech the vowels may be given specific color names.

Because tone and color are so often related, Zeitz did an experiment in which the subjects saw color and heard pitch at the same time. When a low pitch was used the colors seemed to get darker and when a high pitch was used the subjects saw the colors as lighter. In some cases the difference was so great that one color changed to the next hue above or below the first in the spectrum, i.e., orange seen with a low pitch appears red and with a high pitch appears yellow.<sup>76</sup>

Many composers feel that certain musical sounds are definitely related to specific color sensations and, with this in mind, have composed music.<sup>77</sup>

An experiment, conducted at Dartmouth College by Henry S. Olbert, Theodor F. Karwiski, and A. B. Eckerson, showed that subjects listening

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<sup>74</sup>Ibid.

<sup>75</sup>Ibid.

<sup>76</sup>Ibid., p. 94.

<sup>77</sup>Abbott, op. cit., p. 211.

to classical music saw definite colors. These colors seemed definitely related to the mood of the music and were associated as:

red and orange - passionate and exciting  
 pink - serene  
 yellow - humorous and gay  
 green and blue - dreamy  
 purple - majestic  
 brown - doleful  
 white - spiritual<sup>78</sup>  
 black - tragic

These associations are quite similar to the results in the color and mood-tone association tests discussed in a previous section of this chapter.

Thus color in art is more than just a visual stimulus, it is a mood creator and awakens all the senses to be used together in strange new ways.

A study presented in The Measurement of Meaning has to do with the "Effect of Color on the Meanings of Sculptured Objects." Abstract sculpture was used in order to avoid contamination of recognized familiar objects. The scores were obtained by using a semantic differential. The results showed significant overall differences in reaction to hue on the warm - cold, serious - humorous, and masculine - feminine scales, and highly significant interaction between objects and color. Blue was the most favorable in the evaluative factor. The potency factor was directly correlated with the saturation of the colors and the activity factor was directly affected by the hue.<sup>79</sup>

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<sup>78</sup> Henry S. Odbert, "Music and Color Association", Science News Letter, XXXVI, p. 45.

<sup>79</sup> Osgood, op. cit., pp. 301-302.

6. Colored Light and the Theater - Two studies have been done concerning audience reaction to colored light specifically for the theater. The first was done in 1938 by Robert T. Ross.<sup>80</sup> He began with three preliminary studies to work out the pitfalls and the methods. Trial A involved twenty-eight students in advanced lighting courses who named the hues, saturation, and intensity of each color and described the situation it best suited on stage. All the colors were produced by Brigham gelatins in front of a baby spotlight and projected on a screen. The colors were adjusted to an equal illumination value. The results were so jumbled that no satisfactory classification could be made. It was found that despite contrary instructions, the subjects recorded images of things rather than feeling-tone which accompanies an image and with which Ross was primarily concerned.<sup>81</sup>

Trial B was the same as A except that it was given to seventy-seven sophomores in a psychology class. The results again produced no consistent order. There appeared to be some general basic elements but there were just too many different words and images.<sup>82</sup>

Trial C involved twelve students from an experimental psychology class. They were asked to respond, with mood names only to five photographs of a set shown under five different colored gelatins. Each of the five pictures was shown under each of the five lights at different times and then the five colors were tested alone as were the five photographs. The responses again were quite varied, but, there did appear

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<sup>80</sup>Robert T. Ross, "Studies in the Psychology of the Theater", The Psychology Record, II, (April, 1938) 5, p. 131.

<sup>81</sup>Ibid., p. 132.

<sup>82</sup>Ibid., p. 133.

to be certain similar tendencies.<sup>83</sup>

From the first three tests it was decided that a definite rating scale was needed. The following scales were picked on a basis of type of response from the first three sets and the opinion of the directors on what was important to them:

Emotionality  
Affectivity  
Activity  
Tension  
Temperature  
Tragedy  
Comedy  
Melodrama  
Romance<sup>84</sup>

Each of these scales was divided into ten units, with neutral in the center and high on the left.

The purpose of Set D was to test the reaction to color names and to see if a consistency of response could be expected using the above scales. The instruction sheet had the name of the color at the top, but no colors were seen. The test group were twenty-three students in an advanced acting class. The results showed blue and grey were considered cold and red the hottest color. In addition, there seemed to be a definite correlation between high values for tragedy and low values for comedy and temperature. There is, however, little or no relationship between activity and tension, at least one could not be predicted from the other. High saturation was associated with high emotion, high tension, high temperature, high comedy, and high melodrama; while high brightness was associated with low emotion, high activity, low tension,

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<sup>83</sup>Ibid., p. 134.

<sup>84</sup>Ibid., p. 135-137.

high temperature, low tragedy, high comedy, low melodrama, and low romance.<sup>85</sup>

In Trial E, an untrained, unsophisticated audience was presented with the actual colors, projected as Trial A, and were told no color names. They were also asked to write down hue, saturation, and intensity as well as mark the color on the scales. The results showed that the variation of hue judgment was very low, but on the other hand the subjects had difficulty in making judgment of relative brightness. The results of the scales were: Tragedy - cold hues, any saturation, low brightness; Comedy - hot hues, high saturation, high brightness; Melodrama - any hue, high saturation, low brightness; Romance - cold hues, any saturation, low brightness.<sup>86</sup>

Trial F was the same as Trial E except that the subjects from Trial D were used in it. It was done one month after D. The results showed a high degree of correlation between just the color name and the actual color. In other words, the audience responded to the colors as they said they would. Trial E and Trial F which were identical in procedure corresponded well in their results. Ross found that over all, group judgment was more reliable than individual and that the theater group was better at describing than the non theater group.<sup>87</sup>

Stirling Huntley in 1957 did a similar experiment.<sup>88</sup> Fifty-nine subjects were shown seven colors which were projected onto a light gray screen on a stage and responded to them on the theater semantic

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<sup>86</sup>Ibid., pp. 157-158.

<sup>87</sup>Ibid., p. 182.

<sup>88</sup>Stirling L. Huntley, "Some Emotional Reactions of a Theatre Audience with Regard to Colored Light", (Thesis Abstracts) Speech Monographs, XXIV, (June, 1957) 2, p. 128.



differential.<sup>89</sup> He found that for most of the eleven scales hue was important. The exception was the heavy - light scale. There saturation took precedence. The hot-cold scale was also very meaningful in terms of hue. The results closely resembled the mood-tone finding.<sup>90</sup>

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<sup>89</sup>The explanation of this rating method is on page 42 .

<sup>90</sup>Stirling, op. cit., p. 129.

## SUMMARY

The studies discussed in this chapter were concerned with color and effect in two different ways. The first type of effects discussed was direct and involved physiological reactions to colored light. From them one can see that man does react in different ways to the different colors of light. Though the effects are not great in preserving life, they should not be ignored. In some cases colored light has been successfully used in the treatment of mental and physical disorders.

There is one organ which is strongly and directly effected by colored light. It is the eye, whose primary function is the perception of light. Studies showed, however, that eyes, even those of an individual, vary in sensitivity to color and light.

The second type of effect involving colored light discussed was symbolic; that is the color is associated with an idea or an object and the reaction is made on the basis of the color as a symbol. Motor and mental efficiency experiments showed that different colors and different intensities of light changed the rate which people do both mental and motor work.

In studies involving color preference, the object or idea which the color symbolized was not specifically expressed by the subjects, but tests in which the subjects were asked to state reasons for their choices definitely indicated that the responses were due to symbolic or associative effects of colored light. Specific studies show that blue and green closely followed by red are the colors preferred in colored lighting. Yet, it is difficult to compare the studies, because the hues, intensities, brightness, and duration of exposure varied from experiment

to experiment and each one of these factors is important.

Somewhat associated with color preference studies are those in which the subjects were asked to associate color with mood-tones. In these studies there does seem to be a definite correlation between the choice of associations made and the culture, socioeconomic and intelligence levels of the subjects.

Rorschach physiologists feel that perception of color involves a certain passivity or more primitive way of thinking than perception of form, and that except for artistic individuals, people can not perceive form and color equally well at the same time. Investigations into the area of senaesthesia seem to also point to special relationships which the artist has to the things in his world. It seems he has keener perception and can utilize more of his senses in perceiving an image. Not only does there appear to be a strong relationship between color and painting, but also color and music and color and the theater. Studies showed that in the context of theatrical art different colors of light are definitely associated with different types of moods, scenes, and plays. These theater lighting studies, however, only involved the colored light media, and not the actors nor plays. It is know that the effect of colored light is considerably different when it is viewed alone as compared to when it is shone on an object, and that though it moves the meaning of the object in the direction of the meaning of the color, it also may change the effect of the color.

## CHAPTER III

### THE EXPERIMENT

In the previous chapter the results of former studies were discussed. It now remains to turn to the specific experiment with which this study is concerned. In this chapter the methodology of the experiment will be explained in detail so that the reader may be able to visualize it and thus, understand more clearly its purpose. Throughout this chapter it will be worthwhile to keep in mind the questions which it is hoped that this experiment will be able to answer:

Question 1: Does colored light have an effect on a performance?

Question 2: If so, does it affect the actor or the audience, or the actor and the audience?

#### Subjects

The subjects used in this experiment were all students at Montana State University, most of them under-graduate students from freshman Psychology, Speech and English classes. Two graduate students and a few students from Art classes also participated, but no drama majors were used as subjects. They were all volunteers. Originally, each trial was to have ten subjects, however, some tests had only nine, because not all of the subjects came, or in two cases, they were disqualified for having just read the entire play. All of the other subjects were completely unfamiliar with the play. There were sixteen trials, each with a new audience, so a total of one hundred fifty-six students were tested.

Since part of the purpose of the experiment was to find out if the actor is affected by colored light, the two actors who performed the scene were also being tested. Therefore, they may be considered subjects as well as the audience groups.

### Materials

1. The Masquer Theater, the smaller of the two theaters at Montana State University, was used for this experiment. It is an arena stage with two sides, the west and south sides, open to the audience. The other two sides of the stage are draped with black curtains. There is an entrance to the stage at the northeastern corner and at its southwestern corner through the inner lobby. The stage is twenty-three feet, six inches by twenty-three feet four inches. Although not a proscenium stage, it was used as such, and the scene was done only for the west side where all of the experimental audience sat. The purpose of this was to keep the audience as one group, rather than spread out all over the auditorium, in order to simulate more closely true audience conditions. A floor plan of the theater is included in Appendix A.

2. A scene from the play SHADOW OF A GREAT ROCK, a new play written by Dean Regenos, a Montana State University student, was presented by two drama majors, Georgia Tree and Delburt Unruh. The play was a part of the Department of Drama's offering for the 1963-64 season. It was directed by a faculty member and was presented in the Masquer Theater for the public one week after the experiment was conducted. The play was rehearsed during the evenings of the week of tests, but the specific scene which was used in the experiment was not polished or changed once the experiment

was conducted. The play was rehearsed during the evenings of the week of tests, but the specific scene which was used in the experiment was not polished or changed once the experiment was in progress. Neither the director nor the actors knew the exact nature of the experiment. The scene was, therefore, given no special attention but readied only for normal presentation within the total play.

The scene was picked because it seemed an entity in itself, and involved strong interaction between the two characters. It had a very definite mood or feeling and was visually and auditorially exciting. A copy of this scene is found in Appendix B.

3. No sound effects or music was used in the presentation of the scene during the experiment.

4. The actors wore the same costumes throughout all the trials. The man wore dark gray slacks, a light shirt, and a medium gray cardigan sweater. The woman wore a black shirtwaist dress.

5. Two 500 watt Fresnel spotlights were used as a source of illumination. Spotlights of this kind are extremely useful in the theater because they produce a soft-edged beam, and the instruments themselves provide high light efficiency.<sup>1</sup> A downstage center area, oval shaped of about twelve by eight feet, was evenly lit by these Fresnels. These instruments were hung on the second lighting pipe on the west side. Their location and the area which they lit is shown on the Floor Plan of the theater in Appendix A. The angle at which the light hit the stage was approximately sixty degrees. The instruments were about eight and one-half feet up in the air and four to five feet from the front of the stage.

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<sup>1</sup>Bowman, op.cit., pp. 80-81.

This provided sufficient lighting, (1) for the audience to be strongly aware of the color and (2) to illuminate the needed acting area. For the color, Brigham gelatin<sup>2</sup> was used; number seven, "Dark Rose Pink" for the red trials and number thirty-three, "Medium Blue" for the blue trials.

6. The audience used glasses in every run to keep the factors constant. It was necessary for the audience to wear glasses for some of the trials in order to test separate audience and actor reactions. The lens were clear plastic and Brigham gelatin number seven, "Dark Rose Pink"; number thirty-three, "Medium Blue"; number fifty-six, "Dark Straw"; and number fifty, "Light Lemon", over number forty-seven, "Light Green". The frames of the glasses were made out of cardboard with a string to tie at the back of the head. They could be worn over other glasses if necessary and were so designed that they allowed little or no light leakage around their edges. Twelve pairs of each of the five types of glasses were made to take into consideration the possibility of breakage.

7. Scoring sheets were used each time to test the audience reaction to the scene. These sheets were composed of a semantic differential which is basically a combination of controlled association and scaling procedures developed by Charles Osgood.<sup>3</sup> A concept is differentiated by indicating the direction and intensity on a seven step bi-polar adjectival scale. The semantic scales deal with the connotative aspects of meaning more immediately than with the denotative aspects of it and, therefore, are extremely applicable to aesthetic studies. It is, however,

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<sup>2</sup>Chapter I, Definition of the Terms, page 8.

<sup>3</sup>Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning (Urbana: University of Illinois Press, 1957), p. 20.

<sup>4</sup>Ibid., p. 290.

a highly generalized technique of measurement which must be adapted to the special requirements of the specific research problem.<sup>5</sup>

Raymond G. Smith after studying Osgood's method for deriving a semantic differential, decided that it would be worthwhile to make one especially for speech work and one especially for the theater. He replicated Osgood's developmental research in concepts, subjects, and scales which seemed meaningful in the general fields of speech and theater arts.<sup>6</sup> His speech semantic differential was the first of the two to be completed. In order to obtain the theater semantic differential he used one hundred subjects; all were enrolled in drama courses at the University of Indiana, but ranged from freshmen with just three semester hours in drama to graduate students who had one-hundred and ten semester hours. The mean number of drama credit was 19.65.<sup>7</sup> These subjects rated ten concepts which were arbitrarily picked because it was thought that they would probably have meaning for theater students. The concepts were: acting, comedy, stage business, directing, dress rehearsals, learning lines, stagecraft, playwrighting, theater history, and tragedy.<sup>8</sup> These concepts were then rated on thirty scales part of which were the bi-polar adjectives which had been the most significant in the speech test. A 30,000 item cube of data was thus used for the study.<sup>9</sup> Out of this research Smith determined four factors or dimensions useful for a theater semantic differential. They are: (1) manner or action, (2) seriousness or mood,

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<sup>5</sup>Charles E. Osgood, George J. Suci, and Percy H. Tannenbau, The Measurement of Meaning (Urbana: University of Illinois Press 1957), p. 20.

<sup>6</sup>Raymond G. Smith, "A Semantic Differential for Theater Concepts", Speech Monographs, XXVIII, No. 1 (March, 1961), p. 2.

<sup>7</sup>Ibid.

<sup>8</sup>Ibid.

<sup>9</sup>Ibid.



(3) ethical value, and (4) esthetic value.<sup>10</sup> Each of these four factors were represented by several scales. Finally the most accurately measuring scales were picked, two or three for each factor, and the final theater semantic differential was as follows:

Ugly - Beautiful  
 Light - Heavy  
 Honest - Dishonest  
 Worthless - Valuable  
 Calm - Excitable  
 Displeasing - Pleasing  
 Serious - Humorous  
 True - False  
 Painful - Pleasing  
 Cold - Hot  
 Tense - Relaxed<sup>11</sup>

The following written instructions were placed before the test itself:

Consider carefully the scene you have just watched and rate it on the following scales. These scales measure meanings and there are no "correct" or "incorrect" ratings in the usual sense. There are seven steps on each scale. A mark at one end of the scale means extremely. If for instance, you checked the first scales as follows it would mean that you felt the scene to be extremely ugly.

UGLY: X : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : BEAUTIFUL

An X in the position second from either end on any scale means quite. A check in the middle position of any scale means that you are neutral or undecided. Only one position should be checked on each of the eleven scales, but please check all eleven. Please do not look back and forth through the items. Do not try to remember how you checked items earlier in the test. Make each item a separate and independent judgment. Work at fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate "feeling" about the scene, that we want. On the other hand, please do not be careless, because we want your true impressions.<sup>12</sup>

The total scoring sheet looked like the one on the following page.

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<sup>10</sup>Ibid., p. 7.

<sup>11</sup>Ibid., p. 5.

<sup>12</sup>These instructions were a combination of the ones which Smith used in his Semantic Differential for the Theatre and those Osgood used in establishing the original Semantic Differential (Ibid. Osgood, op. cit., pp. 82-83).

PLEASE READ THE FOLLOWING CAREFULLY:

Consider carefully the scene you have just watched and rate it on the following scales. These scales measure meanings and there are no "correct" or "incorrect" ratings in the usual sense. There are seven steps on each scale. A mark at one end of the scale means extremely. If for instance, you checked the first scale as follows it would mean that you felt the scene to be extremely ugly.

UGLY: X : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : BEAUTIFUL

An X in the position second from either end on any scale means quite. A check in the middle position of any scale means that you are neutral or undecided. Only one position should be checked on each of the eleven scales, but please check all eleven. Please do not look back and forth through the items. Do not try to remember how you checked items earlier in the test. Make each item a separate and independent judgment. Work at fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate "feelings" about the scene, that we want. On the other hand, please do not be careless, because we want your true impressions.

The scene was:

UGLY: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : BEAUTIFUL

LIGHT: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : HEAVY

HONEST: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : DISHONEST

WORTHLESS: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : VALUABLE

CALM: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : EXCITABLE

DISPLEASING: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : PLEASING

SERIOUS: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : HUMOROUS

TRUE: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : FALSE

PAINFUL: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : PLEASING

COLD: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : HOT

TENSE: \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : RELAXED

Procedure

As has been stated earlier, sixteen trials were made in this experiment. Four tests a day, on Monday, Tuesday, Thursday and Friday, were scheduled. Wednesday was left out in an attempt to decondition the actors. Each day's experiments were run at 8:30 A. M., 10:15 A. M., 1:15 P. M. and 4:15 P. M. The tests were spread out so that the actors could get out of character and the mood of the scene, and so that, it was hoped, each time they did the scene it was fresh.

All of the tests involving blue light were done on Monday and repeated again on Friday, and all of the tests involving red light were done on Tuesday and repeated on Thursday. The repetition was done to check the consistency of the performance and the reliability of each trial. New gelatins were used each day because this type of light filter has a tendency to fade.

Trial A<sub>1</sub> which was presented on Monday and Friday mornings at 8:30 A.M. represented a combined actor and audience reaction to blue light. The audience wore clear glasses and the light from the Fresnels was filtered with the blue gelatin which was placed in color frames directly in front of the light lens. Both the audience and the actor saw blue.

Trial B<sub>1</sub> was presented at 10:15 A. M. on Monday and Friday and was done with the audience wearing blue glasses and the spotlights had not filter, although empty color frames were put in front of the lights so that the actors, though they would know the condition was different, would not know a filter was missing. In this run the audience saw the scene in blue and the actor saw it in white.

Trial C<sub>1</sub>, presented Monday and Friday at 1:15 P. M., was done with the audience wearing glasses of "Dark Straw" gelatin to neutralize the blue

which was in the color frames in front of the spotlights. Thus, the audience saw the scene in white, and the actor saw the scene in blue.

At this point it seems necessary to interject a word of explanation as to how this last effect was achieved. On a light color wheel it can be seen that opposite blue is yellow or amber, the complementary of blue. It is made up of the other two light primaries - red and green. Theoretically, when a color and its complementary are mixed in equal amounts the result will be white light.<sup>13</sup> The blue gelatin absorbs most of the red and green light from the spotlight allowing mostly blue light to pass. Some red and green light as well passed because the gelatin chosen was not a deep shade of blue. The "Dark Straw" gelatin in the glasses allowed red and green light to pass but little blue. Since, however, there was little red and green light on the scene, roughly equal amounts of red, green, and blue reached the audience's eyes and they saw the scene in white light.

It must be realized that although the audience saw white light both in Trial C and D, there was a difference in the intensity of the white light.<sup>14</sup> The experimenter was unable to equalize the intensity under all conditions for both the audience and the actor, however, an attempt was made to decrease the difference for the audience between Trials C and D. In Trials A, B, and C the stage lights were set at their full intensity which was then decreased by the color filter in the glasses or in the color frames before the spotlights. In Trial D, the stage lights were set at about two-thirds of their full intensity. While this did not entirely

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<sup>13</sup>Rowman, op. cit. pp. 97-98.

<sup>14</sup>See Definition of Terms - Colored Light Chapter 1, page 9.

equalize the conditions, it did decrease the difference for the audience without being apparently different to the actors.

Trial  $D_1$  at 4:15 P.M. on Monday and Friday was done with the audience again wearing the clear glasses which were used in  $A_1$ , but this time there was no filter for the spotlights, so that both the actors and the audience saw the scene in white.

On Tuesday the same tests were done only this time  $A_2$  used clear glasses and "Dark Rose Pink" in the color frames in front of the spotlights,  $B_2$  used the red glasses and empty color frames,  $C_2$  used the glasses which were a layer of "Light Green" and "Light Lemon" gelatin, and the red in the color frames (again for the same reasons as were explained above), and  $D_2$  used the same identical conditions as did  $D_1$ .

In order that the total schedule of trials in the experiment may be readily comprehended, the table on the following page has been prepared.

The three colors of light with which this experiment is primarily concerned are blue, red, and white. The "Medium Blue" gelatin used to achieve the blue in the experiment was, on stage, a bit light, but quite a true blue. The "Dark Rose Pink" was picked over the true red because it was easier to negate and appeared as a lighter, but quite intense, shade of red to correspond with the chosen blue filter. The white which comes from the incandescent lights is not a true white, but rather a yellow white. The objective was to achieve this yellow white when neutralizing the other two colors.

#### Instructions

1. The actors were told to do the scene for the west

## BLUE Trials - Monday and Friday

	A <sub>1</sub> - 8:30 A.M.	B <sub>1</sub> - 10:15 A.M.	C <sub>1</sub> - 1:15 P.M.	D <sub>1</sub> - 4:15 P.M.
Filter used in: glasses	Clear	Blue	Amber	Clear
spotlight	Blue	Clear	Blue	Clear
Color seen by: audience	Blue	Blue	White	White
actor	Blue	Blue	Blue	White

## RED Trials - Tuesday and Thursday

	A <sub>2</sub> - 8:30 A.M.	B <sub>2</sub> - 10:15 A.M.	C <sub>2</sub> - 1:15 P.M.	D <sub>2</sub> - 4:15 P.M.
Filter used in: glasses	Clear	Red	Green and yellow	Clear
spotlight	Red	Clear	Red	Clear
Color seen by: audience	Red	Red	White	White
actor	Red	White	Red	White

audience only- that is to shift their blocking a little, and to stay in the lighted area. They were given no further instructions except that once they began their trials they were not to change or improve upon their characterizations, but to do the scene the same way and as well as they could every time. They were instructed to go on stage after the house lights went out, to present the scene when the stage lights came up, and to leave the stage when it was blacked out at the end of the scene.

2. The audience was asked to sit together in the middle of the second and third rows of the west side of the Maquer Theater. They were each given a pair of glasses (appropriate to the run) and told not to put them on until the house lights went out. When the house lights went out they were to put on the glasses, over their own if they wore glasses, and when the stage lights came up they were to adjust the glasses for light leakage. Then they were told to be attentive to the scene presented before them.

The house lights were dimmed out, the audience was given sufficient time to put on their glasses, while the actors took their places on stage, and then the stage lights were brought up to a high constant level of intensity for the duration of the scene. At the close of the scene the stage lights were dimmed out, the actors left the stage and the theater, and the audience was told in the darkness that they could remove their glasses. The house lights were brought up and the glasses were collected. Next the scoring sheets were passed out to all of the subjects. They were told only to follow the directions very carefully, and that when they had finished taking the test, they were to turn their papers over and remain

seated. When everyone was finished, the scoring sheets were collected. The subjects were then asked if they were familiar with the play, were cautioned against discussing the experiment, and were thanked for their participation. They were allowed to leave.

This was the procedure for all of the tests except the C trials. The experimenter found it impossible to negate entirely the color in the light on stage with the colored glasses used in the normal manner. In these trials the procedure was the same as in the others except that it was necessary to have the audience subjects see the stage light first. They were told to keep their glasses off when the house lights went out and the stage lights came up. Then they were given twenty seconds to look at the colored light on the empty stage, at which time, they were told to put on the colored glasses while the stage lights dimmed down and the actors came on stage. By this means, they were able to see the scene in completely neutral or white light. The reason that this more involved procedure was necessary on the C tests was that the filters in the glasses used with the already filtered colored light were not strong enough to completely absorb all of the color and allow only the remaining white light which had passed through the first filter to reach the eyes. There is, however, a natural phenomenon which causes the eye to see the complementary of a color immediately after termination of the viewing the first color.<sup>15</sup> This reaction does not last long, but it was sufficient to completely remove the blue or red after it had been stared at and the glasses were applied in the darkness. The scene was short and the eyes once adjusted to the neutral tone continued seeing it throughout the scene.

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<sup>15</sup> L. T. Troland, "Psychology of Color", Scientific American Supplement, LXXXVI, p. 114.



## CHAPTER IV

### PRESENTATION AND INTERPRETATION OF DATA

The individual results of each trial were given the value of:

-3, -2, -1, 0, +1, +2, +3

on the appropriate seven steps of each scale and then summed. The sum of each scale was then divided by the number of subjects in each trial (either nine or ten), to obtain the average score for each scale in every trial. Next the results of alike trials (Monday A<sub>1</sub> and Friday A<sub>1</sub>, etc., and Tuesday A<sub>2</sub> and Thursday A<sub>2</sub>, etc.) were combined and a total average of each of the eleven scales was obtained for each of the eight different trials. Since all of the D trials were identical, the D<sub>1</sub> and D<sub>2</sub> trials were averaged both separately and then together. These results appear in Tables 1, 2, and 3 on the following pages.

It is important to remember in interpreting this data that in the A trials both the audience and the actors saw the scene in color, in the B trials only the audience saw the scene in color, in the C trials only the actors saw the scene in color, and in the D trials both the audience and the actors saw the scene in white light. Scores with a minus before them refer to the first adjective in the pair and those with a plus refer to the second adjective.

#### Interpretation of the Individual Scales

In order to understand the data more clearly graphs were made for each scale. The "-.-" represents the I or Blue trials and the "---" represents the II or Red trials. The graphs were placed in the following

Average scores for the Semantic Differential for the Theater under various colored lighting conditions:

TABLE 2  
BLUE LIGHT TRIALS

Scales	Conditions				
	Audience saw Actor saw	A	B	C	D
		blue blue	white white	blue blue	white white
Ugly - Beautiful		+1.255	+1.050	+ .890	+ .350
Heavy - Light		- .465	- .900	- .495	- .600
Honest - Dishonest		-1.170	-1.350	-1.670	-1.200
Valuable - Worthless		-1.465	- .700	- .835	- .600
Calm - Excitable		+ .110	+ .300	+ .220	+ .050
Displeasing - Pleasing		+1.515	+ .800	+1.280	+ .500
Serious - Humorous		-1.720	-2.250	-2.000	-2.350
True - False		-1.155	-1.600	-1.610	- .650
Painful - Pleasing		+ .970	+ .200	+ .330	+ .700
Cold - Hot		- .050	+ .400	+ .330	+ .450
Tense - Relaxed		0	- .650	- .500	- .150

TABLE 3  
RED LIGHT TRIALS

Scales	Conditions				
	Audience saw Actor saw	A	B	C	D
		red red	red white	white red	white white
Ugly - Beautiful		+ .550	+ .500	+ .950	+ .885
Heavy - Light		- .850	-1.050	- .800	- .775
Honest - Dishonest		-1.550	-1.110	- .800	-1.725
Valuable - Worthless		- .950	- .830	- .350	- .940
Calm - Excitable		- .350	+ .390	+ .400	- .110
Displeasing - Pleasing		+ .600	+ .560	+ .850	+1.000
Serious - Humorous		-2.600	-1.555	-2.150	-2.390
True - False		-1.250	- .945	-1.250	-1.165
Painful - Pleasing		+ .300	+ .885	+ .800	+ .445
Cold - Hot		+1.180	+ .895	+ .500	+ .500
Tense - Relaxed		- .300	- .825	- .850	- .165

TABLE 4  
WHITE LIGHT TRIALS

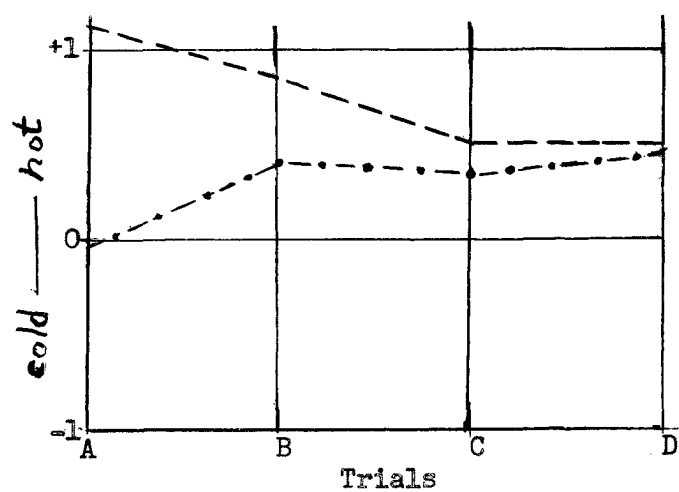
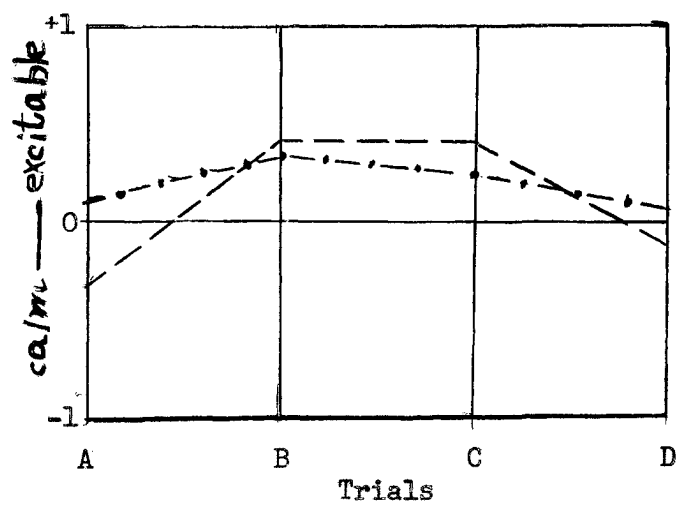
Scales	Same lighting conditions: Actors and Audience saw white at all times	Conditions		
		D <sub>1</sub>	D <sub>2</sub>	Average
Ugly - Beautiful		+ .350	+ .885	+ .618
Heavy - Light		- .600	- .775	- .688
Honest - Dishonest		-1.200	-1.725	-1.463
Valuable - Worthless		- .600	- .940	- .770
Calm - Excitable		+ .050	- .110	- .030
Displeasing - Pleasing		+ .500	+1.000	+ .725
Serious - Humorous		-2.350	-2.390	-2.370
True - False		- .650	-1.165	- .906
Painful - Pleasing		+ .700	+ .445	+ .425
Tense - Relaxed		- .150	- .165	- .158

order so that scales which represented the same factor could be compared. In most cases, the difference between individual scales was too great to make combining them into factor graphs practical for a clear interpretation of the data.

1. Action Factor.- On the following page are the graphs for the two scales, calm - excitable, and cold - hot, which measure the action factor. The first scale varied so slightly that it does not seem worthwhile to try to present a discussion. On the other hand, in the second scale, cold - hot, the variation is more than one whole point and its plotting seems to show a direct correlation of colored light on the number of people who see it. The scene itself seems to be emotionally a rather warm scene, yet when it was done with both the actors and the audience seeing it in blue light the response was slightly cool or neutral. Trials B and C for the blue light are very close, but both are warmer than A. The warmest for the blue trials was D in which no one saw blue light only white. In contrast when both the actors and the audience saw the red light, the scene was judged warmest of all. As fewer people saw the red light the scene appeared less warm. The D result is in quite a neutral position in comparison to the extremes of the red and blue in the A trials. In the action factor it appears that the audience is more effected by the colored light than the actors, although they too appeared somewhat effected by the color.

2. Mood Factor.- The second factor to consider is mood. It is measured by the scales heavy - light, tense - relaxed, and serious - humorous. The mood of the scene, itself, was quite serious, and somewhat tense and heavy. From the graph it appears that the audience when seeing the color alone as in the two B trials reacts more strongly to it than when only the actors see the color, the C trials, or when both the audience and

GRAPH 1 - ACTION FACTOR

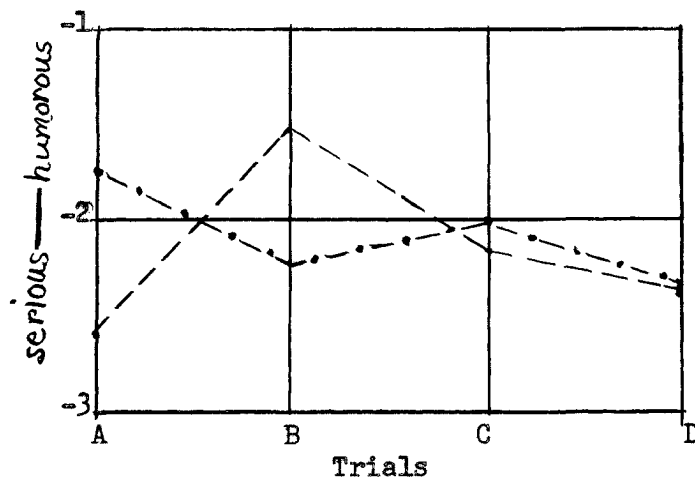
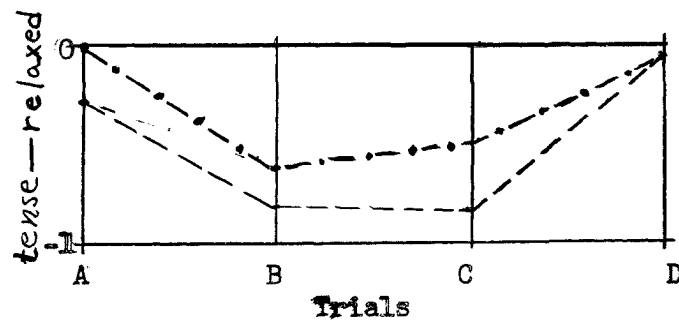
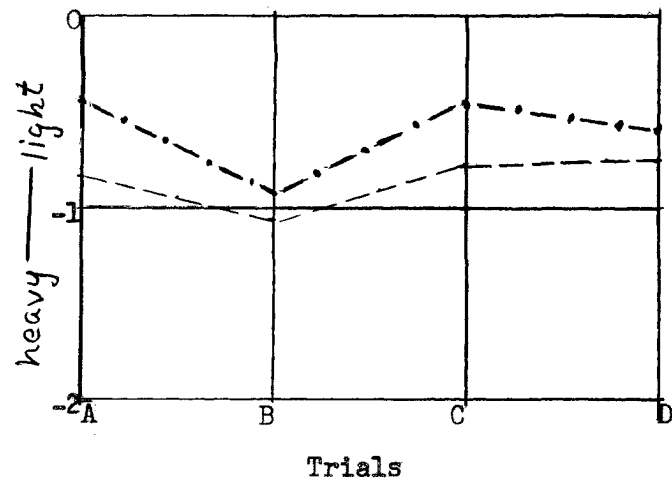


actors see the color, as in the A trials. The blue trials had a stronger variation than did the red trials, about .5 difference, but this is not very much. The red appeared to make the scene a bit heavier, but the differences between the red and blue are too small to really make a case.

In the second scale, tense - relaxed, the red appears to make the scene more tense than the blue, but again the difference is very small. It appears here that both the actors and the audience felt the scene to be more tense when they each saw the color alone rather than when it was presented to them together. There is, however, another fact which must be considered and which seems to have an effect on the results for these scales - that is that the colored glasses used in trials B and C by the audience made the scene appear more intense than when the color was only in front of the spotlights.

As has already been stated, the scene appears quite serious. Even under all white conditions, trial D, the scene was rated as 2.4 on the serious side. Here it appears to be the audience who is the most strongly affected by the color. In the first trials, A, red made the scene appear far more serious than in any other run, yet, when the red glasses were used, trial B, the scene appeared the least serious. The blue glasses had the opposite effect of the blue light; the scene appeared more serious than in any other blue trial. If it is the glasses which caused the effect, then the effect may be said to be due to intensity. On the other hand, the actor seeing the scene in white light may have reacted differently, so that when the audience saw it in color there was a reverse action. In trial C the actors appeared to react a little to the light and in red the scene appeared more serious than when only the audience saw it, while in blue it appeared a bit less

GRAPH 2 - MOOD FACTOR



serious than under the conditions of B. The scene done in white, the D trial, was viewed as more serious than either the B or C trials, but not as serious as the red A trial.

In general then, the mood seems to be affected by the intensity of light, and in the first two scales, heavy-light and tense-relaxed, the actors appear to be more strongly affected than the audience by itself, although the audience and the actor together seem to react to the colors, with red appearing, in all but one of the twelve trials, heavier, more tense, and more serious than the blue.

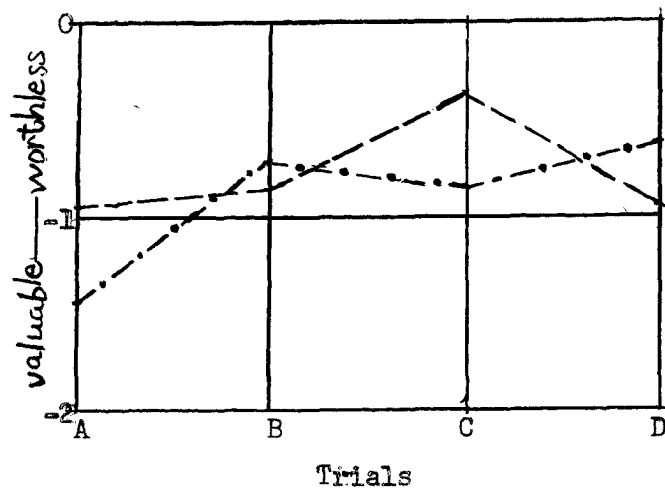
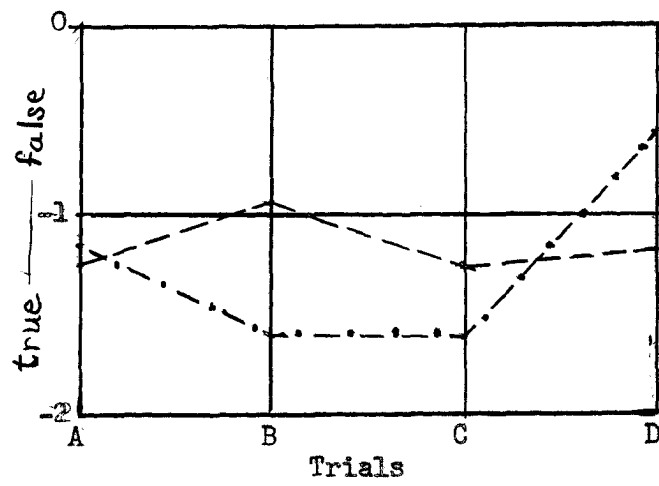
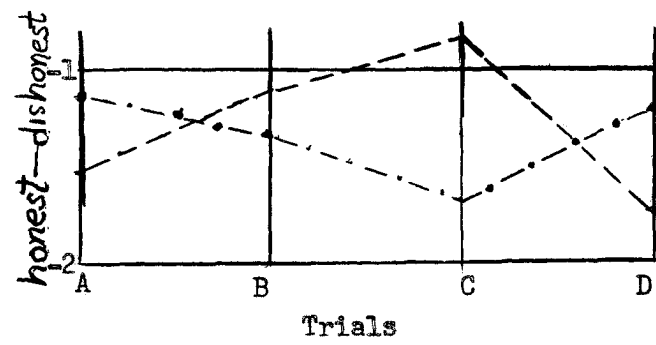
3. Ethical Factor.- The third factor to be considered is ethical value. It may be thought that this would be inherent within the text, yet as can be seen on the graphs, there was considerable variation through out the trials, and strangely enough the D runs had almost as wide or wider variation in them than the A runs of the same scales. It might appear then that perhaps the color has a controlling effect on the audience as far as this area is concerned, where as under white light there is more room for individual differences and feelings.

The results of the first scale, honest - dishonest, show that the scene was in all trials considered quite honest, all of the ratings are below a minus one. The difference between the scores of the colors increases when the actors alone see them than when either only the audience sees the colors or when both the audience and the actors see the scene under the influence of the colored light. To the actors, and the audience, separately, the scene appears more honest when it is done in blue light rather than red, yet, when they both saw the scene in color, A, red appeared a little more honest than did the blue.

The same was true in trial A of the second scale, true-false,



GRAPH 3 - ETHICAL FACTOR



although the differences here were even less than in the honest-dishonest scale. In fact, they may be considered negligible. When, however, the audience and the actors, see the color separately, B and C, the scene appears much more true under the influence of blue than under the influence of red. The reversal and difference of the D trials may be due, as has already been stated to the loss of a control over both the audience and the actor.

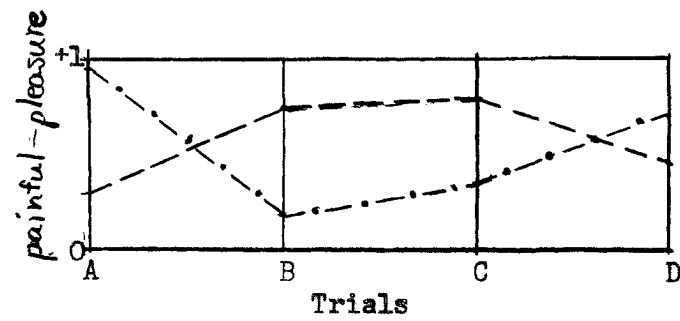
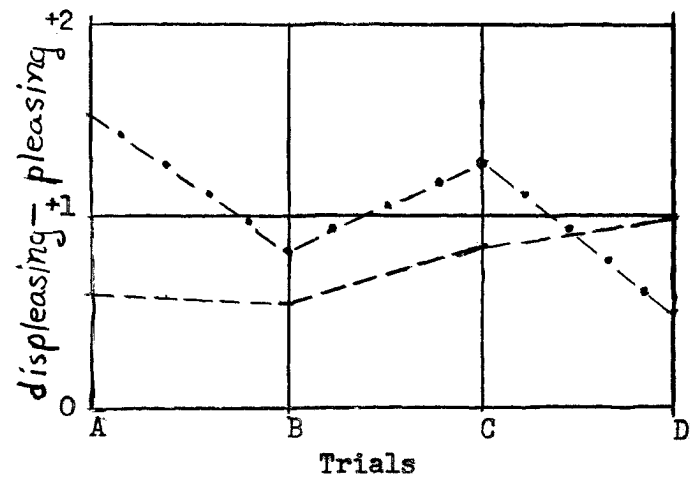
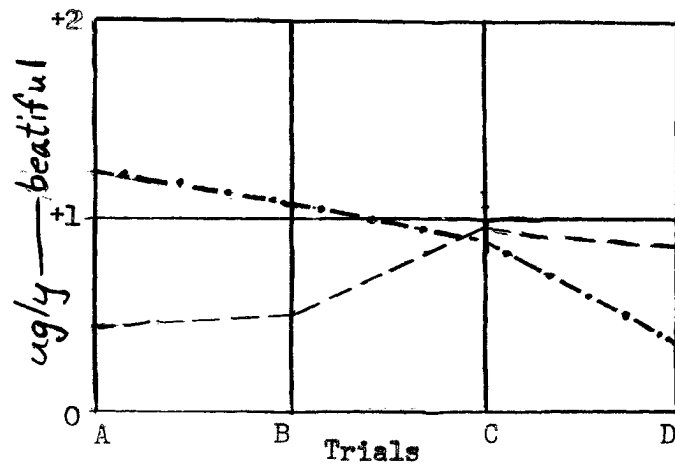
The last scale, valuable - worthless, also shows the blue to make the scene appear more valuable than the red, except in trials B where there is no real difference. It definitely appears here that it is the actors who are most effected by the color. The audience response by itself is no different, but the audience-actor combination registers the same difference as the actor alone except that the first trial is felt to be somewhat more valuable under conditions of A.

For the most part the ethical value appears more true, more honest, and more valuable under blue light than under red.

4. Aesthetic Factor.- The fourth factor in the Semantic Differential for the Theater is the aesthetic value. As its name implies, it is concerned with the artistic and natural beauty of the scene. The three scales, ugly-beautiful, displeasing-pleasing, and painful-pleasing, represent the aesthetic value.

The ugly-beautiful scale shows a definite preference for blue light over red. The fewer number of people who see the blue light the less beautiful the scene becomes, until in white it is least beautiful. On the other hand the red is less attractive than the blue in both the A and B trials but the response is almost identical. In trials C and D where the audience viewed the scene under white light the scene was more attractive,

GRAPH 4 - AESTHETIC FACTOR



though still not as beautiful as when the audience saw the scene in blue light. Thus, on the ugly-beautiful scale it is mainly the audience which is affected by the colored light.

On the second scale, displeasing-pleasing, of this fourth factor, the red light again is found to most strongly affect the audience in making the scene appear displeasing. The blue is more pleasing in all three color trials, but the intensity of it when only the audience saw it seems to have a lowering effect on its pleasantness. It again appears that the color is a controlling factor, for once it is removed the D trials seem to have great variation which may be due to individual reactions to the content of the scene.

In the third scale, painful-pleasing, the reversal between A and B can only be explained in the same way that it was for serious-humorous--that is that the result may be due to a change in intensity of the color, or to the actors' reaction to the change and doing it under white light. It appears that both audience and actor are affected by the colored light on this scale. Runs A and B, though reversed, are about equally apart. This would explain a strong audience reaction. On the other hand, the C trials are closer together, indicating that the effect was not as great on the actors. In D again there is the reversal which, as has been suggested earlier, may be due to the loss of some sort of control which the color exerted and a giving way to individual reactions and differences.

#### General Results

It may appear at this point that there are too many varied responses to be able to answer the original questions:

1. Does colored light have an effect on a performance?
2. If so, does it affect the actor, or the audience, or the actor and the audience?

Yet, it does appear from examining the tables and graphs that the colored light has some effect on a performance. Such scales as cold-hot, tense-relaxed, serious-humorous, and painful-pleasing all show differences in their A, B, and C trials, but close similarities in their D trials. On the cold-hot scale the scene was made to appear colder by the use of blue light and warmer by the use of red. In order to tell just how much of an effect the colored light had on the performances, it was necessary to check these results by significance or probability formulas. A result is considered significant when it is proven that it can only occur by chance five or less times out of a hundred trials.<sup>1</sup> Neither test showed any truly significant results. In three of the four scales mentioned above, the results were quite low and very similar which in itself may be taken to be somewhat significant. They were: hot-cold .14., painful-pleasing .14, and serious-humorous .15. This means that there were fourteen or fifteen chances out of one hundred that these same results could occur by chance. Therefore, all of the results must be taken as tendencies and not truly significant results. The wider the variation the closer the scales approach real significance, so that those scales which have little or no variation cannot be considered.

According to the results of this experiment and the associated studies discussed, it appears that colored light has some effect on a performance. The experiment which was presented seemed to indicate that in almost every case both the audience and the actors were affected by the colored light. In the three scales which approached significance, hot-cold, painful-pleasing, and serious-humorous, both the audience and

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<sup>1</sup>To test the validity of the results in this experiment a Two by Two Factorial Design and the Probability Formula for Two Independent or K Independents was used.

the actors reacted to the colored light. In addition, the audience seems to be more strongly affected when they alone saw the colored light than the actors were when they alone viewed the colored light. In most of the scales the combined audience - actors reaction was the strongest.

As has been stated before these are tendencies which need to be further explored. The results of the experiment were not scientifically significant.

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND IMPLICATIONS

#### Summary

Briefly the results of the experiment are as follows: of the eleven scales used to measure the effectiveness of colored light on a performance, three approached significance in that they were .15 or less on the probability factor. In other words, there were fifteen chances or less out of one hundred that these same results could be achieved by mere chance. These three scales were: hot-cold .14, painful-pleasing .14, and serious-humorous .15. The hot-cold scale showed that for this specific scale both the actor and the audience appeared to be most affected by the colored light. The painful-pleasing scale showed the audience to be more affected by the color, and the serious-humorous scale also showed the audience to be even more affected by the colored light than the actor as compared to the painful-pleasing scale. Further results showed that red light seemed to make the scene appear hotter, more serious, and somewhat more pleasing, while blue light seemed to make the scene appear colder, less serious, and somewhat less pleasing. Both of these colors were compared with each other and the white light for this result.

#### Conclusions

It may be concluded then that: (1) colored light does seem to have some effect on a performance, and (2) it appears to affect most strongly the audience, though somewhat the actors, and in most cases both the audience and the actors.

Difficulties of the Method

In considering implications of these conclusions, it is important to remember that the subjects used in the audience were not, except for a very few, people who regularly or even seldom attended the theater. This may be an important factor in the results. Rorschach said that only two types of normal people, the "nervous" and the artists were able to respond to color without losing some of the perception of form. Theater is an art form and as such it attracts the artist and the more sensitive or as Rorschach calls them, the nervous, not only to work in it, but also to enjoy it. Therefore, the subjects used may have been less inclined to notice the color, because they were concentrating more on form. This, however, might not be true of a more experienced theater audience who could grasp both the form and color at the same time and be more strongly moved by both perceptions. It would seem feasible that the actors would be able to perceive color and form equally well, in which case the color would have some effect on their performance on interpretation of the scene.

It is also possible that the reaction of the audience was restricted by its relatively small size. The audiences may have been self-conscious and not able to lose their individual identities while watching the scene.

The fact that different trials were performed at different times of the day may have had some effect in itself. A possible control may have been to arrange the trials to fall so that only one trial would be done a day.

The actors, too, may have needed to be more carefully controlled, although it is extremely difficult to keep the human element entirely constant.



The scene which was used may also have been a bit strong for a naive audience in terms of ideas and emotional experience presented. People unused to such a bold presentation may have reacted in two ways; they may have been shocked by it and given a more negative response or they may have wished to appear undisturbed by the scene and therefore, given a more cautious response. In either case, the results would not be as extreme as if honest reactions had been given by a more theatrically sophisticated audience.

Colored light might, also, have had a stronger effect if the scene had been less emotional or dramatic, and one which involved more common, unemotional experiences.

It also should be kept in mind when considering implications that there was one factor in the experiment which varied between the different trials - that is the intensity of the light. There seemed to be no practical way to keep this factor constant for both the audience and the actors. From some of the results it appears that the intensity of the light played an important role. For the audience trial B although the same hue as trial A appeared more intense because of the color filter being in the glasses, rather than directly in front of the light. The audience saw trial C and trial D, both in white, but D was much brighter again because of the glasses. The problem was one that if the intensity was kept relatively constant for the actors (although even this varied depending on the filter used) it was considerably greater in variation for the audience. Yet the actors were the same every time while the audience was new in each trial so that it seemed more necessary to keep the actors' intensity constant if a choice had to be made.

### Implications

Generally, the tendencies which seemed to occur fitted with the reactions of the color and mood-tone experiments which were discussed in Chapter Two. Red was found hotter and more tense, while blue was colder and more relaxed.

In considering the two previous experiments done with colored light for the theater, it must be noted that although significant results were obtained the only elements of the dramatic art which were used, were in one case, pictures of a set, in the second case, the theater auditorium itself, and in both cases, the theatrical lighting equipment and gelatin filters common to this art form. Yet, the most important elements, the necessary elements of theater, the actor and the play were absent. It does not appear in these two experiments that the essential parts of theater were examined. Osgood in his discussion of colored light on abstract sculpture said that the response would be far different for recognizable items under the light. Walton, in experiments with colored light on a bare wall, also cautioned against assuming the results would be the same when the colored lights were used in conjunction with familiar objects. It would seem, therefore, that in order to really make any sort of worthwhile studies the important elements of the theater - the actor and the play - must be used.

### Practical Applications

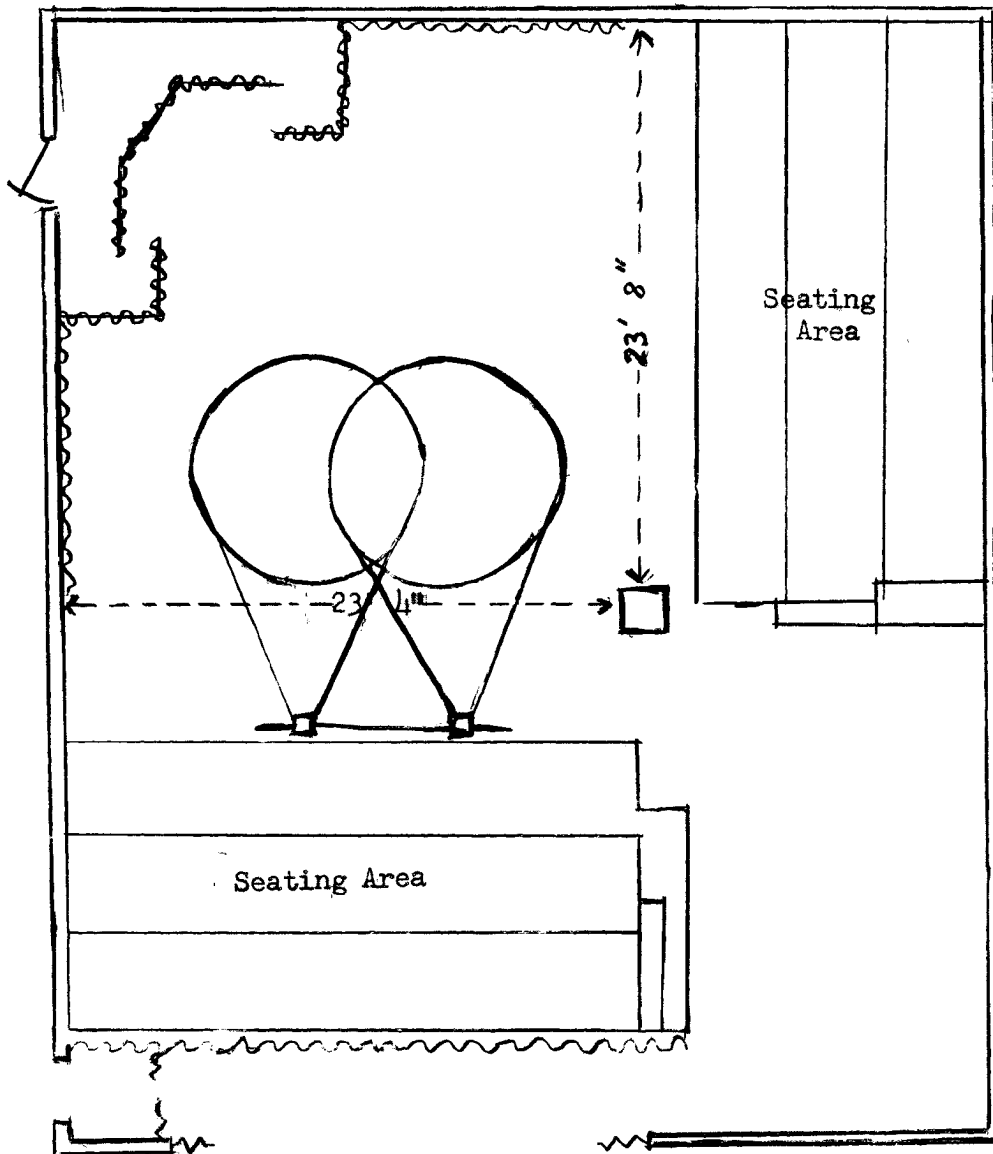
Even though there were only three tendencies which approached significance it may be worthwhile for the director and lighting designer to consider them in planning the stage lighting for a show. If for example, one were directing KING LEAR the storm-mad scenes could be

presented in blue light so that the effect would appear to be cold and displeasing. On the other hand, if the scenes in which the sisters are plotting were done in red light it would seem to have the effect of heat and seriousness. This is only one example, many more could be given. It is up to the director or lighting designer to decide what the important element is that he wishes to express in a scene or play and then remembering the tendencies, that red lighting seemed to make the scene hotter, more serious, and somewhat more pleasing, and blue lighting seemed to make the scene cooler, less serious and somewhat less pleasing, he can use the tendencies as a guide for lighting for his production.

The purpose of this study, however, is not to be a practical guide to stage lighting. It was to test old concepts and to open a new area of research. It is by no means a definitive study; it is instead a beginning. It is hoped that others, interested in this area, will investigate the tentative results achieved in this study. A method for examining the effect of colored light on a dramatic performance has been proposed and tested. Unsuccessful parts and pitfalls which the investigator encountered, have been explained. More detailed and controlled experiments, however, need to be performed before the experiment can have much practical value outside of laboratory conditions, on the stage itself. What ever research that is done in this area, it is important to remember that theater is art. Once its artistic elements are removed it is no longer theater. In Chapter I, it was stated that the purpose of the investigation was not to reduce this art form to sheer scientific equations. If this means not getting mathematically significant results then at least tendencies are shown. Yet, this is not a defense, for the investigator feels that it is possible for the experiment to be done another way so that significant results can be obtained. Future research in this area, however, must

take into consideration all of the unexplainable and mystic qualities which make theater the art form that it is.

APPENDIX A



Masquer Theater  
Montana State University  
Scale -  $1/8" = 1'$

## APPENDIX B

The following is the text of the scene from SHADOW OF A GREAT ROCK by Dean Regenos which was presented for the experiment. It is reprinted here by permission of the author.

Caution: SHADOW OF A GREAT ROCK is fully protected by copyright. No part of it may be acted or publically read by professionals or amateurs without written consent from the author.

(SCENE 6: ANDREW IS SITTING BY HIMSELF IN A GLADE. ELLEN ENTERS BEHIND HIM.)

Ellen

Why are you there so pensive?

(NO ANSWER AND SHE LOOKS AROUND)

It is a nice spot you picked,

The trees closing in, the creek over there,

And the edge of the canyon farther on.

Andrew

(BECOMING AWARE OF HER BUT DISINTERESTED)

It is a place I know.

Ellen

Why do you come here into all this loneliness?

Andrew

There are people who have never touched or felt a quiet moment.

I am satisfied where I am.

Ellen

But there is more to life than the silence we conjure up in

Ourselves. There's the noise, The chaos. Those are the  
Things I like.

Andrew

Those are city sounds.

Ellen

Those are the sounds I know. I know what to expect from them.

It's too quiet here.

You don't know me, do you?

but, I know your brother, Abram, very well,

(ANDREW TURNS SHARPLY AWAY)

What is wrong?

Andrew

I was thinking.

There is a plan afoot.

I am heir apparent to my brother's life.

Ellen

There is nothing wrong with his life.

It is a good life.

Andrew

I would not know. It is not mine.

Ellen

You are too young to worry about such things.

Andrew

I am not young

Today I am the eldest.

The eldest must be a man.

Ellen

Do you expect to grow in an instant?

Andrew

I have no choice.

Ellen

Growing is not a pleasant prospect.

Andrew

In its pace it is fine.

Ellen

But you seem a man. You know the land. The country,

Andrew

Yes, I suppose those things I know.

Ellen

(CHARINED THAT HIS THOUGHTS HAVE TURNED FROM HER)

What is that there?

Andrew

Angle Ridge. And beyond that is Baring Mountain. And beyond that is Pass Creek. And on and on and on. All around, Three hundred and sixty degrees of knowledge. Worthless.

Ellen

Why?

Andrew

Because it will change. They will dam Pass Creek and there'll be a new lake. The valley behind it will be gone and the mountains will change with the sweep of the water. It will be a different land. Then they'll cut the mountains for highways and level the rest for homes. It will take a while, but it will happen.



Andrew

I suppose so. In the way people like to think of "good places."

Ellen

Then what are your fears? You are safe here.

Andrew

People. I do not know people.

They are alien in this place.

Ellen

I'll bet you know all about women though, don't you?

Andrew

Only what my father says.

And he has a deep hatred.

Ellen

But you are not your father.

You are Andrew.

Almost a man....

Andrew

A man!

Ellen

All right, a man.

And you have the right to your beliefs.

To your life.

You should do. Act.

Find out what you need to know.

And if you want to learn the ways of women,

I am here.

Andrew

I don't know you.

Ellen

Does it matter?

You will learn of me soon enough.

Come.

Andrew

There is deceit in woman, my father says.

Ellen

If there is deceit you will find it.

But perhaps you are still the younger man.

Perhaps you are not yet the man you intend to be.

And Abram lives on.

With you behind in the shadows.

Andrew

No, damn you.

I will learn your wares if this is what it is to be a man.

Ellen

It is a step. Come here.... Come on

We must touch for the lesson.

Here. To me. Slowly.

It is better if done slowly.

I rub myself to you.

Now.

We will begin with a kiss.

The softness of a kiss.

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